

NASA TECH BRIEF



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Fatigue Cracks Detected and Measured Without Test Interruption

The problem:

To detect cracks, nondestructively, in materials undergoing fatigue test, without interfering with test progress. Commonly used methods utilizing penetrating liquids, magnetic particles, and optical techniques all involve interruption of the fatigue test.

The solution:

An ultrasonic flaw detector with modified transducers clamped to the specimens, and an oscillograph readout. This system provides a permanent, continuous record of cracks encountered throughout the fatigue tests without any need to interrupt or interfere with the tests.

How it's done:

Detection of fatigue cracks by the reflection of ultrasonic energy is similar to the use of radar in the detection of distant objects. Acoustic energy, in the form of pulsed envelopes of high-frequency waves, is transmitted from a transducer into the test specimen. After the pulse is transmitted, the transducer acts as a receiver for energy reflected from any discontinuity in the specimen. The metal-air interface of a fatigue crack constitutes such a discontinuity. The low density of air and the relatively low velocity of ultrasonic waves in air result in an acoustic mismatch that causes the reflection of incident ultrasonic waves. The amount of energy reflected from a crack is directly related to the crack area, the intensity of the

incident ultrasonic wave, and the orientation of the crack.

The through-transmission technique for the detection of discontinuities does not depend on the measurement of reflected energy. It employs two transducers: one acts as a transmitter, the other as a receiver. The principle of operation is based on the fact that a crack in the region of the specimen between the transducers will decrease the energy transmitted to the receiver. The amount of energy received is inversely related to the crack area.

The oscillograph readout is coupled to a gating circuit, permitting a permanent record to be made of signals received from flaws in a selected portion of the specimen, while the test is running.

Note:

Inquiries concerning this innovation may be directed to:

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Reference: B66-10178

Patent status:

No patent action is contemplated by NASA.

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